What lives under large logs in Tasmanian eucalypt forest?

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Introduction

Almost wherever you walk in Tasmania's forests, you encounter logs. They come in a range of lengths, diameters and stages of decay, and can dominate the ground layer. There must be few amongst us who can honestly say that they have never felt the inclination, even if only in childhood, to explore them, to find out what they're made of and to try and figure out what lives in or under them. Even a cursory look hints at the wealth of nature that makes use of logs - slaters, scorpions, spiders, beetles, fungi, mosses, lichens, skinks, snakes and quolls to name but a few. Many of the logs we encounter are too large to move, which can cause consternation since we suspect these large logs are harbouring the most interesting creatures. If only there were a way we could find out what lives under those logs! If only we could borrow one of those big forestry excavators for a few days and take a peep into that secret world!

As luck would have it, we were given exactly this opportunity early in 2006, as part of a study into the habitat preferences and conservation requirements of the broad-toothed stag-beetle *Lissotes latidens* in Wielangta Forest. This beetle is listed as endangered under the *Tasmanian Threatened Species Protection Act 1995* and under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. Through the work reported in Meggs and Munks (2003) it was already known to live under small logs in wet eucalypt forest (the sort of logs that people can roll over unaided by machinery), but it seemed nobody could say whether it also occurred under larger logs in either wet or dry forest. A project was devised to try and find out. This paper is primarily derived from the internal research report arising from this work (Grove, 2006). That report focused on beetles, particularly on *L. latidens*. In this paper we shift the focus away from this species to cover all the beetle species recorded as well as other 'incidental' species records.

What did we do?

The study was conducted in Wielangta State Forest, south of Orford in the hinterland of Marion Bay. We located six unharvested forestry coupes within the range of *L.latidens* in Wielangta that in combination gave us equality of sampling effort between wet and dry forest types and which had sufficient roading for ease of access and to avoid unnecessary damage by the excavator. Details of these study sites are given in Grove (2006). *Lissotes latidens* is thought to live at the soil-log interface (Meggs and Munks, 2003); hence the survey procedure was tailored to optimally sample this habitat. It involved two methods: live pitfall-trapping around large logs; and rolling of large logs using an excavator. These methods were applied to different areas of the chosen coupes, to avoid any interference of one survey method with the other while keeping the findings comparable at the coupe-scale. In the event, pitfall-trapping was conducted in five of the six coupes used for log-rolling. Live beetles encountered (other than field-identified *L.latidens*) were collected into alcohol, and added to the Tasmanian Forest Insect Collection maintained by Forestry Tasmania.

Fifty-five person-days were spent on fieldwork overall. Survey work was conducted under an amendment to DPIWE Permit no. TFA 05232.

Live pitfall-trapping

Pitfall traps, of a standard design widely used in work of this nature, were installed at a spacing of about 3 m or so along the length of each of the 54 large logs selected for this sampling approach (34 in dry forest and 20 in wet forest), and in close proximity to the log in question (162 traps in total). If the ground immediately adjacent to the log was too stony to dig in a pit, it was dug in a little further away from the log, and a short section of rigid corrugated plastic ('Corflute') inserted between the log margin and the trap (running at right angles to the log), as a barrier to channel any insects towards the trap (Figure 1). Only sections of log apparently in contact with the soil were considered suitable for sampling. A small amount of leaf-litter was placed in each trap to provide cover for any animals caught. Small holes were also made in the base of the plastic cups to prevent drowning in the event of rain. Trapping was conducted over a four-week period in January and early February 2006, and traps were checked every few days. Logs in wet forest were generally longer than those in dry forest, so on average each log in wet forest was able to support more pitfall traps. This explains the difference in the total sampling effort in wet versus dry forest, which amounted to 2242 trap-days in wet forest and1624 in dry forest. At completion of the study period, the traps and flagging tape were removed and the pits refilled with soil.

Log-rolling

A total of 121 logs were selected for sampling, with a combined length of 1114

m. Logs were selected on the basis of minimising habitat disturbance and on excavator accessibility. Many logs were considered unsuitable because they were found to have minimal soil contact due to the stony substrate. After recording key features of the log (see Grove, 2006), the excavator was guided to each marked log whereupon the operator used the machinery to lift or roll the log, putting it down close by before retreating (Figure 2). Where possible, the log was moved in one piece, but logs in a more advanced state of decay generally disintegrated and had to be moved in sections. Often, only a portion of the log ended up being rolled. Thus the actual combined length of logs rolled (896 m) was less than the combined length of logs initially selected for rolling. Of this rolled length, the proportion found to be in contact with soil averaged 32% in wet forest and 24% in dry forest. The newly exposed ground that was beneath the log was searched for beetles and other arthropods, including by raking over the top centimetre or so of soil surface. Adults (but not larvae) encountered, whether live or as dead fragments, were identified on site wherever possible. The excavator was then used to replace the sampled log back as close to its original position as possible.

Figure 1. Pitfall trap design (left) and typical location (right). Photos: Simon Grove.

Figure 2. Four stages in log-rolling using the excavator and subsequent inspection for beetles in Wielangta forest. Photos: Karen Richards.

What did we find?

Table 1 shows the beetle species found during this study. We have not presented separate data here for each study site. Site-by-site beetle data, derived from both live-caught and dead specimens, are presented in Grove (2006). We have also chosen not to separate dry and wet forest data, since few clear patterns were evident, perhaps because of the low numbers of any one species caught. Even *L.latidens* was found in both forest types - see Grove (2006) for a fuller discussion on this.

Table 1. Beetles recorded live during the study in Wielangta forest, January – February 2006.

Family	Species	Pitfall-trapping	Log-rolling
Lucanidae	*Lissotes cancroides*		1
	Lissotes curvicornis		4
	Lissotes latidens		2
	Lissotes obtusatus	3	16
	Syndesus cornutus		2
Carabidae	*Chylnus ater*	7	1
	Notonomus politulus	2	4
	Percosoma carenoides	11	3
	Promecoderus brunnicornis	12	5
	Rhabdotus reflexus	29	
	Simodontus australis		2
	Trechimorphus diemenensis		2
Scarabaeidae	*Telura vitticollis*		1
	Sericesthis nigrolineata	2	1
Tenebrionidae	*Adelium abbreviatum*	1	4
	Brycopia picta		1
	Coripera deplanata	2	10
	Diemenoma commoda		1
	Diemenoma tasmanica		5
	Isopteron triviale		3
	Homotrysis luctuosa		3
Ulodidae	*Ganyme sapphira*		1
Prostomidae	*Prostomis atkinsoni*		26
Curculionidae	*Decilaus striatus*		1
	Dryophthorus ECZ sp 02		4
	Merimnetes simplicipennis		2
	Poropterus TFIC sp 04		1

Pitfall-trapping produced 69 live beetles, comprising nine species. Log-rolling produced a total of 106 live beetles, comprising 26 species. Together these included a respectable five species of stag-beetles (lucanids) and seven species of ground-beetles (carabids). A sixth stag-beetle species, *Ceratognathus niger*, was also found under a log, but only as fragments of a long-dead specimen. Fragments of three dead *L. latidens* were also found in similar condition.

Few non-beetle species were found in pitfall traps, but bull ants *Myrmecia esuriens* were often present in dry forest traps, as were scorpions *Cercophonius squama*. Log-rolling also produced relatively few other species, but amongst the invertebrates the snails *Caryodes dufresnii* and *Helicarion cuvieri*, and millipedes of the genera *Lissodesmus* and *Tasmanodesmus*, were frequently noted. Ants were plentiful and occupied both the logs and the soil beneath. Most abundant were *Iridomyrmex* spp, while *Amblypone australis* was also common. Bull ants *Myrmecia forficata* and *M. esuriens* were often encountered, as were jackjumpers *M. pilosula*.

No vertebrate species were noted during pitfall-trapping. During log-rolling, metallic skink *Niveoscincus metallicus* and tree skink *N. pretiosus* were often encountered under logs, while only a single specimen of Whites skink *Egernia whitei* was found. Two frog species were recorded under logs in very low numbers: brown tree frog *Littoria ewingii* and common brown froglet *Crinia signifera*.

Of most interest were the accumulations of scats of echidna *Tachyglossus aculeatus* which were found under several rolled logs at several of the study sites. The scats appeared to have accumulated over a long period, as some occurred on the ground surface, while others were completely buried beneath soil and debris. All accumulations were beneath logs and were confined to discrete areas of less than 0.5 m^2 rather than being randomly deposited over the total available area. The amount of material varied between sites; however just four of the sites together yielded 2.5 kg of scats, which have been collected for later dietary analysis by one of us (CS).

Are large logs really as interesting as they look?

The combined beetle catch from log-rolling and pitfall-trapping was rather meagre - 175 live individuals from 27 species in total. We had expected to find many more individuals and species living under large logs than proved to be the case. Pitfall-trapping produced fewer species than log-rolling, and all but two of these - the stag-beetle *Lissotes cancroides* and the ground-beetle *Rhabdotus reflexus* - were also found by log-rolling. It is possible to argue that pitfall-trapping adjacent to large logs did not adequately sample the under-log habitat, but this argument does not explain the low numbers found through excavator log-rolling. To only find 105 individual beetles from a total log length of 1114 m of log length, 896 m of which was rolled (i.e. one beetle per 8.5 m of log rolled), implies that living under large logs is not a particularly 'desirable' thing for beetles to do. Of course this study has its own biases - for instance, nearly all the beetle species recorded are relatively large (body length over 1 cm), and individuals of small species may have been missed during hand-searching. This study doesn't allow us to directly compare the occupancy rate with that of smaller logs, but our own experience suggests that the occupancy rate under smaller logs would be higher than this. Nevertheless, most of the species that we encountered do have a genuine association with logs. Besides the ground-beetles and one of the weevils (*Merimnetes simplicipennis*), we consider all the beetle species encountered to be saproxylic (i.e. associated with dead wood - in this case because they probably feed on it). The ground-beetles are all predators and most may have no particular association with logs, although all would benefit from the shelter that logs provide and one, *Chylnus ater*, is thought to be primarily a log-dweller.

Interestingly, in both wet and dry forest the percentage of rolled log length found to be in contact with soil was much lower than that estimated from external examination of the whole logs prior to the excavator arriving. In other words, most sections of most logs were found to be perched on rocks or stones rather than resting on the soil. This is clearly evident in the case of the log shown in Figure 2, and may partly explain the cause of our disappointment. Another possible explanation would be that large logs are simply so heavy that, where they are in contact with the soil, there tends to be little airspace left and the soil is heavily compressed. With the benefit of hindsight, we perhaps should not have expected the ground beneath large logs to host large numbers of beetles since neither the 'perched' condition nor the 'compressed' condition would appear to be particularly good beetle habitat.

None of this implies that large logs don't have other important beetle values. Our study did not look inside large logs, only beneath them. Had we spent our energies (and those of the excavator) breaking open logs we might have had more success. Compare our 27 beetle species to the several hundreds recorded from only 18 large eucalypt logs in a long-term study at Warra (Grove and Bashford, 2003 and subsequent unpublished data) and it is clear that some large log habitat is extremely rich in beetle species.

Though this study was focused on beetles, it does shed some light on the extent to which other animals make use of large logs. Large logs are clearly used by the local reptiles and amphibians, but whether they depend on them is not clear. A more significant finding from this study was the regularity with which we encountered accumulations of echidna scats, which suggests that large logs have a role in providing sheltering or latrine areas for local echidnas, and may enable them to more clearly define their home ranges. Interestingly, CS noted another instance of apparent 'latrine' behaviour at Old Hastings Road in the south of Tasmania in August 2006 while searching for stag-beetles. Several echidna scats were found inside a hollow log. The log had an internal cavity of 35 cm diameter, and was 1.5 m in length and closed at one end. This 'latrine' behaviour is well known in other mammal species and is accepted as being a means of communication between individuals. Platypus *Ornithorhynchus anatinus*, the only close relative of the echidna, has also been found to deposit scats in selected sites in its home range (CS unpublished data).

Acknowledgements

Besides the authors of this report, field sampling and technical assistance also involved Mick Miller, Frank Bishop, Nick Hall, Aaron Jacobson, Tim Wardlaw and Dick Bashford (all from Forestry Tasmania), and their contribution to this study is gratefully acknowledged. Excavator and operator hire was obtained from a local contractor operating out of Triabunna. We also thank Sue Baker for her helpful comments on an earlier draft of this paper.

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